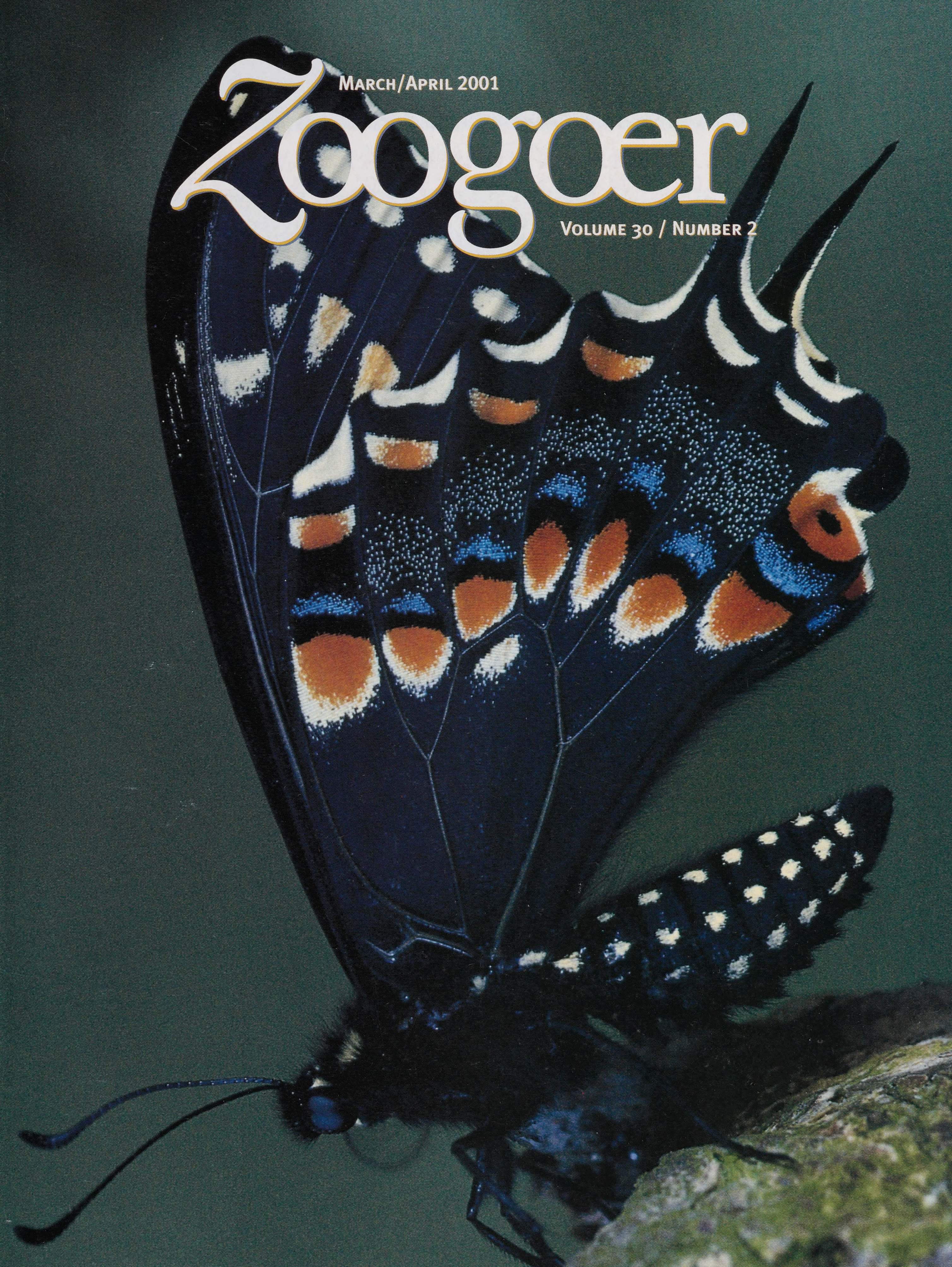


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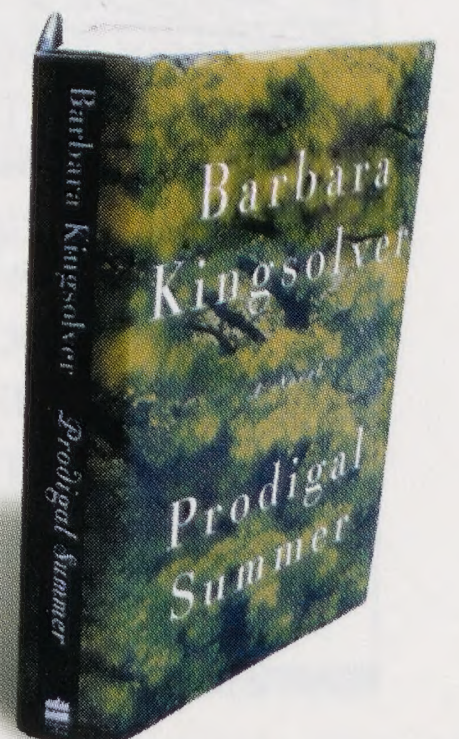
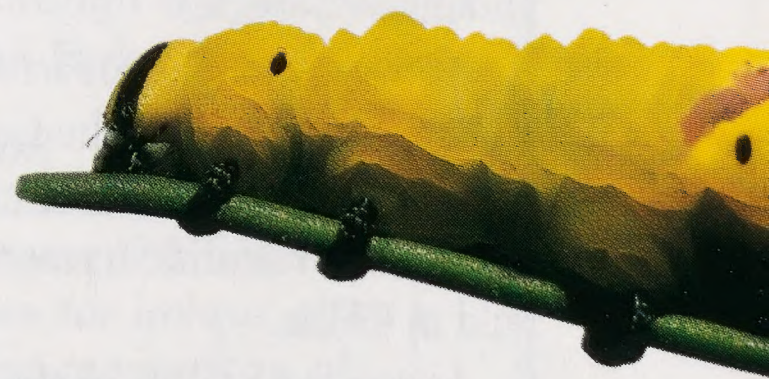
Spring brings elation—and elevation—to the Elephant House, and exhilarating special events to the whole Zoo.

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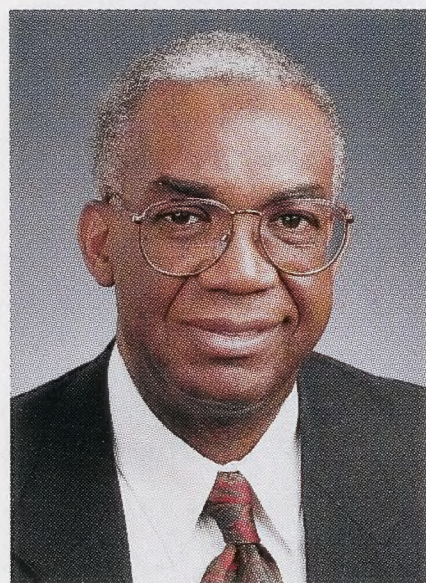
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Awe in Odzala, a nightmare for Darwin, a load of rubbish, and a weave of woolly words.



PANDA EXTRAVAGANZA!

As part of our "Year of the Pandas" at the Smithsonian's National Zoo, festivities celebrating the arrival of giant pandas Tian Tian and Mei Xiang will continue at ZooFari's Panda Extravaganza on May 17. The eighteenth annual gala ZooFari fundraiser hosted by Friends of the National Zoo, Panda Extravaganza is sure to attract more support and create more awareness of the Zoo and its conservation mission than any previous one.



Already the area's finest restaurants are offering to contribute their most delectable gourmet fare. Vintners are more eager than ever to serve their finest wines. Entertainers are clamoring for auditions. Volunteers are designing decorations and signing up to set tables and tend bar. And ticket sales at our online ZooFari ordering page (www.fonz.org/store/zoofariorder.htm) are brisk. Last year's ZooFari, Frog Fandango, netted more than \$370,000. We hope to raise even more at Panda Extravaganza.

People often ask where these funds go. The answer is, everywhere there is a need in the National Zoo. ZooFari funds have contributed to nearly every major new exhibit at the Zoo. Great Cats, Amazonia Science Gallery, Amazonia, Think Tank, Cheetah Conservation Station, and Pollinarium are some of the exhibits ZooFari proceeds have helped to make possible. ZooFari funds also help support many conservation breeding programs, including those for tigers, greater one-horned rhinos, Asian elephants, Komodo dragons, and other endangered species.

And, of course, ZooFari funds have supported and will continue to support the Giant Panda Conservation Fund. The funds helped to bring giant pandas Mei Xiang and Tian Tian to the Zoo and to renovate their habitat; they will continue to support the Zoo's ambitious ten-year program of scientific research on giant pandas, designed to help ensure their conservation in the wild in China.

As you can see, for all the light-hearted fun that ZooFari offers, it has a serious and important mission. Participating in ZooFari is one way everyone can make a contribution to giant panda conservation. And though ZooFari is designed with adults in mind, children (and their parents, of course) can contribute by getting in the swim at Guppy Gala on May 11. This wildly exciting fundraiser for kids has become as popular as the ZooFari fundraiser that spawned it. Proceeds from Guppy Gala help to support our giant panda conservation education programs at the Zoo.

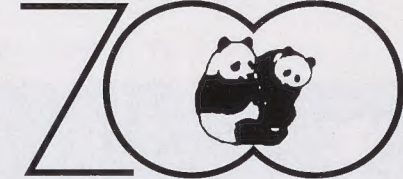
Through these education programs, and by getting to know animals like Tian Tian and Mei Xiang, people are inspired to contribute to the conservation of pandas and their natural habitat in China. And saving habitat for giant pandas saves it for all of the less well-known species with which they share space. It also creates a greater awareness of the needs of all wildlife.

I hope to see all of you at one of these fabulous spring events.

Sincerely,

Clinton A. Fields
Executive Director

Friends of the National



is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the Smithsonian's National Zoological Park as one of the world's great

zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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☉ Smithsonian *National Zoological Park* is located at 3001 Connecticut Ave., N.W., Washington, DC 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From May 1 to September 15, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m. From September 16 to April 30, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m.

Membership in FONZ offers many benefits: publications, discounts on shopping, programs, and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, Washington, DC 20008, call 202.673.4961 or go to www.fonz.org.

Membership categories and annual tax-deductible dues are:

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(\$8 of membership dues goes to a <i>ZooGoer</i> subscription)	

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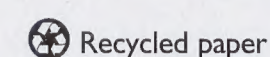
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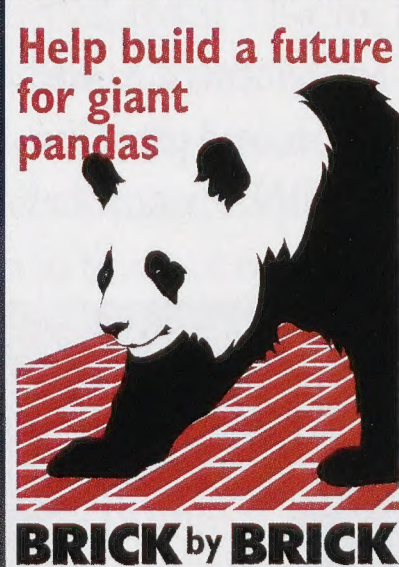
Cover photo: Black swallowtail butterfly (*Papilio polyxenes*). Photo by David Liebman.



Help Build A Future for Giant Pandas— Brick By Brick!

The National Zoo is planning a spectacular new habitat for giant pandas Mei Xiang and Tian Tian: the Fujifilm Giant Panda Conservation Habitat. We invite you to make a contribution toward the new habitat—tentatively scheduled to open in 2003—and, at the same time, leave a lasting impression at the Zoo. For a donation of just \$150, a brick paver engraved with your name or the name of a loved one will be installed in the walkway bordering the new outdoor habitat.

To make a donation and receive a brick paver, call 202.673.4613 or visit our website at www.fonz.org/animals/gpfund.htm.



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NOTES NEWS

ANIMAL NEWS

Griff gave birth! On the morning of January 18—after almost an hour of labor—Griff, the National Zoo's 18-year-old Masai giraffe (*Giraffa camelopardalis tippelskirchi*), delivered a five-and-a-half-foot-tall bundle of joy. The newborn female, named Jana—meaning large or fine child in Swahili—began walking 45 minutes later and was nursing by 11:00 a.m. According to initial reports, the new calf is “beautiful.”



KEEPERS GREET NEWBORN GIRAFFE, JANA.

Also adjusting well to life in Washington, D.C., are Mei Xiang and Tian Tian, the Zoo's two giant pandas (*Ailuropoda melanoleuca*). More than 100,000 people visited the Panda House within the first three weeks Mei and Tian were on exhibit. Seemingly

unaffected by the crowds, the pandas appear engrossed in the daily activities of wrestling, eating, and napping. Be sure to check out our new website solely dedicated to giant pandas at <http://pandas.si.edu>.

One recent arrival at the Smithsonian's National Zoo is even larger than a giant panda or giraffe—it's the new Zoo Bus! This environmentally friendly, natural gas-burning vehicle will shuttle anyone requesting a lift between Amazonia and Panda Plaza. The handicapped-accessible vehicle will accommodate two wheelchairs and about 40 seated passengers at a time.



JANA WITH HER FATHER, RYMA (TOP), AND MOTHER, GRIFF.



GALAS GALORE!

May brings flowers and fun to the National Zoo. Our family fundraiser event, **Guppy Gala**, is scheduled for Friday, May 11, from

6:00 to 8:30 p.m. Children can take part in a wide variety of games and activities, including a climbing wall, a moonbounce, magic shows, and delicious kid-favorite treats like fried chicken and cotton candy. Tickets are \$18 for FONZ members, \$25 for nonmembers. Adults and all children two and older must have tickets for admission. Proceeds benefit Zoo education programs.

FONZ's annual gala fundraiser for adults, **ZooFari**—whose theme this year is “Panda Extravaganza”—will take place Thursday, May 17, from 6:30 to 11:00 p.m. As always, ZooFari will feature fabulous food and drink from more than 100

Washington-area restaurants and vintners, as well as a sweepstakes and silent auction, and great live music. Tickets purchased by FONZ members

by April 30 are \$100 each, and \$110 beginning May 1. Proceeds benefit the Giant Panda Conservation Fund.



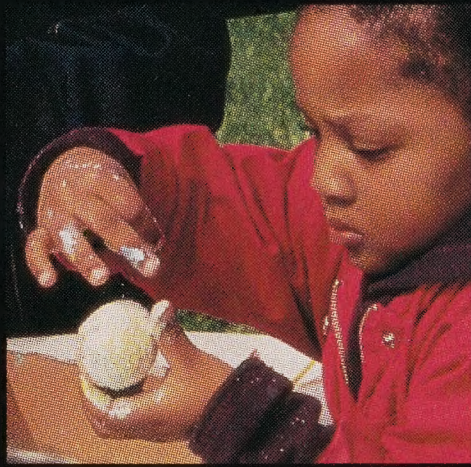
TIAN TIAN (LEFT) AND MEI XIANG SETTLE INTO LIFE AT THE NATIONAL ZOO.

MARCH 17 & 18



Seal Days

APRIL 16



African-American Family Celebration

APRIL 21 & 22



"Find Out Why?"

APRIL 26



Two-Step with the Tigers

APRIL 28 & 29



BirdFest 2001

VERNAL EVENTS

Spring is here, and family events are blossoming. Friends of the National Zoo will host **Seal Days: A Celebration of North American Wildlife** on Saturday and Sunday, March 17 and 18, from 11 a.m. to 4 p.m. This free event, which celebrates the International Day of the Seal, highlights the biology and conservation of grey seals, California sea lions, and other North American animals. Interactive displays, animal demonstrations, keeper talks, great food, and games and crafts for children will entertain, educate, and delight.

Next up on the Zoo calendar is the **African-American Family Celebration** on April 16 from 10

a.m. to 5 p.m. This free Easter Monday jubilee—a tradition for decades in Washington, D.C.—will include an Easter egg hunt, gospel music and African drum performances, folk storytellers, and delicious food.

FONZ will then celebrate National Science and Technology Week with **"Find Out Why?"** on April 21 and 22 from 11 a.m. to 4 p.m. In conjunction with the National Science Foundation, this free event challenges children ages four and up to find out on their own why cheetahs run so fast, why bees are fuzzy, and other zoological riddles. "Find Out Why?" will take place on the National Zoo's Great Meadow, an area that will be

transformed into a gigantic game board, with kids as the game pieces.

Continuing our series of Young Professionals Events, **Two-Step with the Tigers** saunters into town on Thursday, April 26, from 6 to 9 p.m. The event features a two-step lesson, live country music, great food, a cash bar, plus a tiger talk led by an animal keeper. Tickets are \$8 pre-paid, \$10 at the door. Log onto www.fonz.org or call 202.673.4613 for tickets.

Finally, on Saturday, April 28, from 10 a.m. to 2 p.m., and Sunday, April 29, from 11 a.m. to 3 p.m., the National Zoo will host **BirdFest 2001** to welcome back the millions of migratory birds that spend the winter in Latin America and the Caribbean. The free event com-

memorates the eighth annual International Migratory Bird Day. Festivities will include educational displays by dozens of conservation organizations, kids' games and activities, Latin American music and food, a "bird-friendly" shade-grown coffee tasting, presentations featuring live birds, a performance by the Evergreen Theatre, and a wildlife photography exhibit and workshop seminar by renowned nature photographer Arthur Morris. To learn more about the workshops (for which registration and a fee are required), go to www.birdsasart.com or call 863.692.0906. For general FONZ event information, log onto www.fonz.org or call 202.673.4613.

—Matthew Huy

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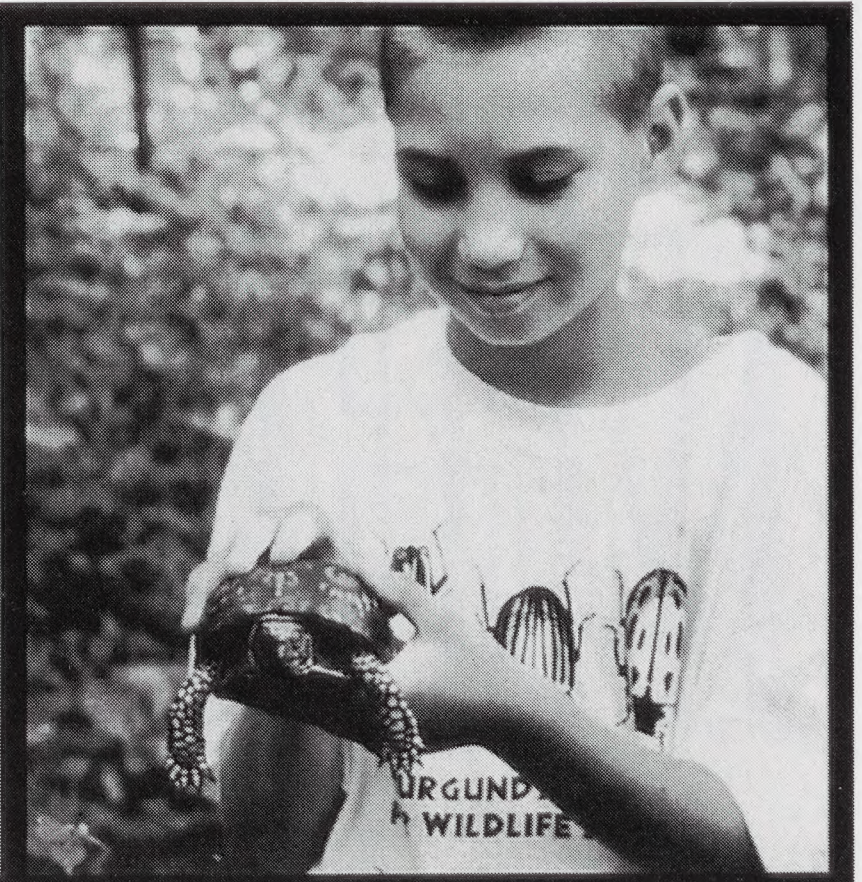
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BY MARI N. JENSEN

Beak pointed at the sky, an alarmed great bittern (*Botaurus stellaris*) sways with the surrounding reeds, relying on its motion and reed-mimicking stripes to blend in. But trying to become one with the marsh cannot allay all danger. In fact, the bittern's dependence on reed beds means its existence is threatened by forces no amount of graceful bending in the breeze will deter: The bird's seaside haunts in Britain may simply vanish as global warming causes oceans to rise.



THE CLIMATE

POLAR BEARS AND OTHER ARCTIC AND ANTARCTIC WILDLIFE ARE FEELING THE EFFECTS OF GLOBAL WARMING.

Across the Atlantic in Delaware Bay's marshes, coastal plains swamp sparrows (*Melospiza georgiana nigrescens*) hop about near the high-tide line in a band of marshes

only about a football field or two wide. This subspecies of sparrow, found only in tidal marshes from New Jersey to Maryland, is also threatened by sea level rise, says Russell Greenberg, an ornithologist who heads the Migratory Bird Center at the Smithsonian's National Zoo. Although the bird inhabits a very populated region of the world, little is known about exactly where it lives. Greenberg just completed the first global survey of the sparrow's haunts this summer. The sparrow, he found, has strict habitat requirements. Although some of the birds now live in protected areas, he says, "It wouldn't take a whole lot of shifting of sea level to put the entire population off of any protected land."

Global warming is affecting far more than just a few rare seaside birds. The more scientists look, the more they are linking climate change to changes in the animal world. Shrinking sea ice makes hunting harder for polar bears and Adélie penguins but is a boon for chinstrap penguins. In Europe, many butterfly species are flitting farther north than ever before as northern climes become warmer. With the milder spring temperatures, birds breed earlier. But not all



DAVID LIEBMAN

CLIMATE CHANGE MAY BE DRIVING SWALLOWTAIL BUTTERFLY POPULATIONS IN EUROPE NORTHWARD.

animals and plants respond the same way to the changes, so interdependent species may get out of synch. And areas like parks and nature preserves

may become unsuitable for the very animals they were designed to protect.

Researchers are now beginning to document species at peril from global warming. From rare gelada baboons, whose cool mountain-top retreat in the Ethiopian highlands may shrink, to Bengal tigers, whose coastal habitat in the Sundarbans mangrove forest along the India-Bangladesh border could become submerged, climate-change effects on wildlife may be fully understood only after it's too late.

Fewer Feast Days in the Frozen North

In winter, the ice covering western Hudson Bay is thick enough to land a helicopter on. Polar bears (*Ursus maritimus*) roam the ice, primarily feeding on ringed seals as they surface at breathing holes in the ice. By March, the bears are at their leanest.

But a bonanza of food is just around the corner. Ringed seals (*Phoca hispida*) give birth in April, providing a banquet for the 1,200 bears that make up the western Hudson Bay population, one of the southernmost of Canada's 14 populations of polar bears. From then until the

CONUNDRUM

ice breaks up in late July, the bears gorge themselves on seal pups, according to Nick Lunn, a Canadian Wildlife Service research scientist who works on the Polar Bear Project. It's crucial that the polar bears pack on the pounds, because when they come ashore after the ice breaks up they subsist on stored fat until the ice forms again in late November.

However, global warming is cutting the bears' feasts short. Spring air temperatures in western Hudson Bay have warmed by nearly four degrees Fahrenheit since 1950. Now, Lunn says, the ice breaks up two to three weeks earlier, forcing the bears ashore sooner. It's a double whammy for the bears—they have less time to put on fat, but the fat they do store must last three weeks longer than in olden days. For the last 20 years, Lunn and his colleagues have seen the bears' physical condition—as determined by an index of various body measurements reflecting how well each bear is doing—decline by about 15 to 20 percent.

The situation is even worse for pregnant females, Lunn says. Rather than go back out on the ice in November, a pregnant female digs an

earthen den in the fall and holes up for the winter. She gives birth to anywhere from one to three cubs in late November. Snug in their den, the new family cocoons together until February or March. All that time, mom's stored fat must not only sustain her, but provide the energy needed to make milk for nursing cubs. Even in good years, by the time she and her cubs emerge to go back on the ice and hunt for seals, she's "very

thin," Lunn says. "The hide is just sort of hanging on [her]."

Researchers at the Polar Bear Project have noticed that the bears are starting to have fewer cubs. At present, the western Hudson Bay population of polar bears is stable, Lunn says, but he adds, "If the trend continues as it is, eventually this population will start to decline." Although he cautions that other forces could be at play, he argues that global warming right now seems the best explanation for what researchers see happening to the bears.

It fits with predictions, he points out. Biologists have suggested that, for creatures adapted to Arctic conditions, those animals living farther south will be the first to feel the effects of global warming. The western Hudson Bay population indeed lives farther south than other polar bears. And in regions where the ice persists as long as it always has, biologists who study polar bears haven't seen the decline in

condition that Lunn and his colleagues have noticed. That could change. Lunn says, "If global warming occurs throughout the Arctic, you're likely to see these things happen elsewhere."

In Europe, many butterfly species are flitting farther north than ever before as northern climes become milder.

Penguins Paddling Farther for Food

In a comparably harsh environment at the other end of the globe, William Fraser has seen Adélie penguin (*Pygoscelis adeliae*) numbers plummet in the last quarter century from 15,200 breeding pairs to about 8,000 pairs. He too attributes the animals' plight to shrinking sea ice and other environmental changes caused by global warming.

Fraser, an ecologist at Montana State University in Bozeman, does his research at Palmer Station, a U.S. research base on the western Antarctic peninsula. In the summer, the





NATIONAL SCIENCE FOUNDATION

SCIENTISTS BELIEVE GLOBAL WARMING IS HELPING CHINSTRAP PENGUINS (LEFT) TO THE DETRIMENT OF ADÉLIE PENGUINS (RIGHT).



NATIONAL SCIENCE FOUNDATION

ocean comes right up to his research site, and Teton-like mountains form the backdrop for the region's tremendous diversity of wildlife, which includes vast breeding colonies of giant petrels, South Polar skuas, elephant and fur seals, and Adélie, chinstrap, and gentoo penguins.

In about 1988, Fraser and his colleagues began to notice unaccountable alterations in the Adélie penguin populations. There was no indication that the food web was changing, but penguins weren't doing so well. The team realized the penguins' winter habitat—the sea ice—had been shrinking as winter temperatures rose. The seven-to-nine-degree Fahrenheit increase in midwinter temperatures that has occurred in the region, he says, is “one of the largest increases on the planet.”

For Adélies, the sea ice isn't just a place to hang out. It serves as a platform for feeding in the food-rich areas of the ocean. In mid-July, the height of the Antarctic winter, the penguins have only a few hours of daylight to forage under the ice for krill, the tiny shrimp-like animals at the base of Antarctic food chains. When the sun limps over the horizon at about 11 a.m., the birds all pop into the water. They stay submerged until about 1:30 p.m. or so, but all jump back out well before dark, which occurs around 2:30 in the afternoon. During those brief feeding bouts, the penguins need to chow down more than enough calories for that day; they must also store up fat for the breeding season ahead.

Fraser suspects that as the ice recedes, it no longer covers the best feeding grounds. Adélies, rather than just plopping into the water right by the best grocery store in town, now have to either swim some distance to find good feeding grounds or forage in the less productive areas right on the ice's edge. Either way, the birds are likely to be getting less food—and expending more energy to get it—than they once did. Fraser doesn't see skinnier birds returning in the spring, but he is seeing fewer of them. The winter



ROB & ANN SIMPSON

NORTH AMERICAN TREE SWALLOWS (*TACHYCINETA BICOLOR*) ARE LAYING THEIR EGGS MORE THAN A WEEK EARLIER ON AVERAGE THAN 40 YEARS AGO.

season, he thinks, is do or die for the penguins: Birds that don't get enough to eat just don't live. This year he plans to outfit about 25 Adélie penguins with satellite tags so he can track the movement of the birds throughout the winter to see how close they stay to the ice.

Depending on where their traditional breeding grounds are, the birds that return may run into additional difficulties. As the globe warms, the poles are getting more winter precipitation. For most Adélies, that's not a problem. But those who nest in places where the wind piles up snow encounter much more snow than in past years. Undeterred, the birds burrow down into the snowdrifts and lay eggs. But if the birds don't reach bare, gravelly soil and instead lay their eggs on the snow itself, the spring thaw renders the nest site an icy puddle.

“There's six inches of water, and the birds are just sitting on the eggs,” Fraser says. If the eggs are flooded too long, the embryos die. Adélies seem to be hardwired to begin breeding at a certain time on the calendar, he says, so waiting until the snow melts just isn't an option for them. “Historically, there was probably little or no snow that time of year,” says Fraser.

Fraser attributes the drop in Adélie penguin numbers to these two global-warming-induced environmental changes—the retreat of the sea

ice and the flooding of nest sites. “The big picture is that the Adélie penguins are retreating,” he says. “But there's a limit to how far [south] they can go—they can't get below the Antarctic Circle because they'll run out of light in the wintertime.”

In the same location, as the sea ice retreats, an ice-avoiding species, the

chinstrap penguin (*Pygoscelis antarctica*), is expanding southward. In 1975 there were eight or nine breeding pairs at Fraser's field site; now there are 300 to 400. “Ecologically, they are the exact opposite of Adélies,” he says. During winter, chinstrap penguins hang out on icebergs in the open sea. And although the chinstraps breed side by side with the Adélies, the chinstraps start about three weeks later, meaning they start after the snow melts.

“As one environment replaces another, the chinstraps are doing well—and the Adélies are not,” says Fraser. For species like Adélies, whose breeding behavior seems triggered by a time on the calendar rather than by environmental conditions, Fraser predicts the speed of climatic change will continue to exceed the rate at which species can adapt.

Swallows and Swallowtails Confounded by Climate

But not all birds are tied so tightly to the calendar. By looking at years of nesting records for 65 species of British birds, ornithologist Humphrey Crick of the British Trust for Ornithology in Thetford, England, reported in 1997 that about one-third of these species were laying their eggs an average of nine days earlier than a quarter century ago. The finding fit in nicely with reports



GREAT BITTERNS (*BOTAURUS STELLARIS*) MAY SEE THEIR COASTAL MARSH HABITAT DISAPPEAR BENEATH A RISING OCEAN.

CHRIS GOMERSALL/BBC NHU PICTURE LIBRARY

that trees are leafing out and insects emerging earlier in Britain.

The British Isles aren't the only place the rites of spring are starting sooner. Upon learning of Crick's work, University of Wisconsin at Milwaukee behavioral ecologist Peter Dunn realized he could do a similar analysis with nest box records for tree swallows (*Tachycineta bicolor*) in North America.

For years, North American birders have gathered information about nesting birds such as the species of bird, nest location, and number of eggs. Birdwatchers then send the data off to central record-keeping agencies—either Cornell University in Ithaca, New York, for U.S. nests, or Toronto's Royal Ontario Museum for Canadian nests. Records on tree swallows are particularly common, Dunn says, because of the hundreds of thousands of bird enthusiasts all over North America who put up nest boxes for bluebirds. "Most of the time they get tree swallows."

Dunn and his Cornell colleague David Winkler found that from 1959 to 1991 the archive had 3,450 good nest records on tree swallows. Unlike Crick's data, which covered a relatively small, homogenous region, the tree swallow nest records spanned North America—stretching

phenomenon like global warming, rather than some local climatic variations in the British Isles or in one part of North America. Other bird researchers are finding similar changes: Mexican

jays (*Aphelocoma ultramarina*) in Arizona's Chiricahua Mountains are laying eggs 10 days earlier than in 1971, reports Jerram Brown, a biologist at the State University of New York in Albany.

To figure out when to breed, birds probably use changes in day length as an initial cue, but the bird's own body condition determines the fine-tuning, Dunn says. Food availability is probably key for determining laying dates. Tree swallows fly around like "little vacuum cleaners" sucking insects out of the air, Dunn says, and appear to breed only after having consumed a certain threshold amount of insects. Dunn is now collecting information to see whether North American insects are indeed emerging earlier than they have in the past.

Tree swallows aren't the only animals in which scientists have seen continent-wide shifts in behavior that seem to track global warming. By

from California to North Carolina, and north as far as Nova Scotia.

Because the records covered such a large geographic area, Dunn didn't expect to find a very clear pattern. He was wrong. Like Crick, he found the birds were laying their eggs nine days earlier than 30 years before. That finding, Dunn says, provides a strong argument that the birds are indeed responding to a worldwide

comparing information from museum records, private collections, and researchers' field notes with current censuses of butterfly populations, Camille Parmesan, a University of Texas at Austin ecologist, showed that the southernmost populations of Edith's checkerspot (*Euphydryas editha*)—a butterfly that ranges from Mexico north into Canada—were winking out faster than those farthest north. This pattern of extirpation, she reported in 1996, would be expected if global warming was driving the changes in the butterfly's distribution.

Not content with seeing the pattern in a single species, Parmesan wanted to know whether a similar global warming signal could be observed for many such species across an entire continent. So she chose Europe, knowing that specimens and records from several centuries of butterfly collecting could be found there. For two years she drove all over Europe, visiting museum scientists

and butterfly collectors from Helsinki to Barcelona and enlisting their help. She and her colleagues spent weeks

poring over butterfly specimens and field notes to tease out the data showing where Europe's 440 species of butterflies used to live and where they live now.

Parmesan wanted to include only butterfly species with large geographic ranges, those found as far north as Britain, Sweden, and Finland while simultaneously ranging south to France and even North Africa. Of the 183 species with such wide distributions, only 35 species ended up as good candidates for the analysis. When the results were in, the researchers saw a clear pattern: Two-thirds of the 35 species had shifted their ranges north in the last 100 years, some as much as 150 miles. "The sheer number of species shifting north is incredible," she says, adding that it's not just the big, beefy fliers like swallowtails that are trekking north generation by generation; fragile little butterflies called "blues" and "coppers" are also making the journey.

Not content with seeing the pattern in a single species, Parmesan wanted to know whether a similar global warming signal could be observed for many such species across an entire continent.

Seeing changes in distribution at the north or south edges of a species' range is exactly what biologists have predicted will happen with global warming. Researchers were careful to screen out any species that might be affected by other factors like habitat loss. "It's the best data set to date on a multi-species system showing the kind of response we expect from climate change," says Parmesan.

Mountain Dwellers Shifting Schedules

Some animals just seem to find the whole thing confusing. At Rocky Mountain Biological Laboratory in Gothic, Colorado, Billy Barr has been recording the first date each spring that he sees a particular animal species. An avalanche watcher for the U.S. Forest Service and business manager for the lab, he lives at the 9,500-foot elevation site year-round. His records show that,



YELLOW-BELLIED MARMOTS (*Marmota flaviventris*) ARE EMERGING FROM HIBERNATION MORE THAN A MONTH EARLIER THAN IN 1973.

although yellow-bellied marmots (*Marmota flaviventris*) are coming out of hibernation 38 days earlier than they did in 1973, least chipmunks (*Eutamias minimus*) are snoozing 11 days longer, and golden-mantled ground squirrels (*Spermophilus lateralis*) 26 days longer.

Although April air temperatures have been getting warmer, the snowpack lasts just as long as it did in the past—late May or early June—because recent winters have dumped much more snow on Gothic. A bit like Punxsutawney Phil,

marmots do come out from time to time, apparently testing the air temperature in order to decide whether to stay topside. If the slumbering chipmunks and squirrels use a different wake-up cue, like the amount of snow over their burrows, that might account for their lolling about below ground so much longer, says Rocky Mountain Biological Laboratory and University of Maryland at College Park ecologist David Inouye.

Animals may be getting out of synch with their food supply, he says. Plants don't start growing until the snowpack melts, which means these days marmots fast an additional month after they emerge. And the squirrels and chipmunks, who stash food in their burrows for bedside snacks, may find the cupboard getting bare. "The animals are either going to have to change their behavior or go locally extinct." (That's exactly what happened to one population of Edith's checkerspot butterfly in California's Sequoia National Forest. The butterflies emerged a week earlier than their nectar plants—and they all died. Parmesan says the dead butterflies made "a hillside of bright orange wings.")

Extinctions may also occur because high-altitude animals' mountain-top habitats just get too toasty. Translucent-winged apollo butterflies (*Parnassius apollo*) flit about high-elevation habitats throughout much of Europe. Lepidopterist Henri Descimon has been watching populations in France's Jura mountains for the last 40 years, according to Parmesan, and he reports that on every single mountain under 2,750 feet the apollo butterflies have disappeared. On those smaller mountains, the butterflies cannot go any higher in elevation in search of cooler climes, so they "get bumped off the mountain." Parmesan says similar things are



GELADA BABOON (*Theropithecus gelada*).

ANDREW MURRAY/BBC NHU PICTURE LIBRARY

happening to endemic populations of *Erebia* butterflies in the Swiss Alps.

Climate Changing Conservation

Climate change is even messing up conservationists's best laid plans. Parks and natural areas set aside to protect a specific endangered species or ecosystem may no longer fulfill that purpose as the globe warms. Biologists stress that climate change is altering environmental

conditions faster than most plants and animals can adapt. Although people can just crank up the air-conditioning, the birds and the bees won't have that option.

Some creatures, like the chinstrap penguins or the butterflies Parmesan studied, are already taking advantage of the climatic changes to move into new territories. Others, like the Adélie penguins, are finding themselves with nowhere to go. Parmesan recommends that conservationists and park managers link preserves in ways that let animals move as the climate warms, such as by providing north-south corridors or corridors that provide a range of elevations.

Humans may have to come to the rescue by creating new habitats. The Royal Society for the Protection of Birds is giving Britain's great (or Eurasian) bitterns some hands-on help. Most of the region's breeding bitterns live next to the coast in reed beds. But the birds don't require oceanfront property—just thickets of reeds. So in England's East Anglia, the Society is building new reed beds 25 miles inland to replace coastal marshes that are sure to be swamped as sea level rises.

Conservationists are slowly beginning to grapple with the challenges that global warming presents. Ken Smith, head of aquatic research for the Royal Society for the Protection of Birds, puts it simply: "Although the issue is now becoming clear, we are only just facing up to devising solutions." Z

—Mari N. Jensen is a freelance science writer who lives in Tucson, Arizona.

The intoxicating birds of New



THE POISONOUS FEATHERS OF HOODED PITHUI (*PITHUI DICHROUS*), ABOVE, AND THEIR CLOSE RELATIVES ON NEW GUINEA HAVE FASCINATED BIOLOGISTS, WHO SUSPECT THAT THE BIRDS' TOXINS MAY DERIVE FROM INSECTS LIKE CATERpillARS (BELOW) OR OTHER SPECIES IN THEIR DIET.



guinea



PHOTOS BY
JACK DUMBACHER

BY JOHN TIDWELL

It all began with an accident. In the summer of 1989, Jack Dumbacher was a graduate student from the University of Chicago conducting fieldwork on the ecology of Raggiana birds of paradise (*Paradisaea raggiana*) in Papua New Guinea's lush Varirata National Park. Dumbacher was one of a handful of graduate students on the National Geographic-sponsored team, and part of his research involved catching and examining these exotic orange-yellow birds in fine mist nets set throughout the forest. Sometimes other birds would also get caught, and Dumbacher spent a lot of time freeing unwanted species like the hooded pitohui (*Pitohui dichrous*), a jay-sized endemic New Guinean songbird with striking black and orange coloration.

For these young researchers, pitohuis (pronounced *PIT-oh-wheez*) were all too familiar: They were everywhere, they fought and scratched when being disentangled from the nets, and they had a pungent odor that stayed on researchers' hands for days—the local people called them “rubbish birds.” One day Dumbacher was freeing yet another hooded pitohui from his nets when its sharp beak and claws scratched his hand.

Dumbacher put his hand in his mouth and got a strange numbing sensation that he recognized as the effect of some toxin. At first he thought nothing of it, because he occasionally brushed against poisonous plants in the forest. It never occurred to him to suspect the bird. But then a few weeks later another member of the team mentioned the same odd sensation when he put his injured finger in his mouth. Again the culprit

was a hooded pitohui. Dumbacher's interest was piqued, so the next year he returned to New Guinea determined to examine some of these rubbish birds more closely.

“The next time we caught a hooded pitohui,” he remembers, “I just plucked one of the feathers and tasted it: *Whammo!* Whatever it was, it was definitely in the feathers.”

There were only a few weeks before the



DANCERS ON THE HUON PENINSULA CELEBRATE THE 20TH ANNIVERSARY OF PAPUA NEW GUINEA'S INDEPENDENCE.

arrival of the research team's leader, Bruce Beehler, then Scientific Assistant to the former Smithsonian Institution Secretary, S. Dillon Ripley. Dumbacher wanted to be as sure as he could that these birds were producing some kind of chemical in their feathers. So he and his three assistants sampled the feathers of several other hooded pitohuis, all with the same tongue-tingling results. As he was driving Beehler up to Varirata from the airport, Dumbacher suggested that the find might make an interesting field note in New Guinea's local bird journal. But Beehler, the man who literally wrote the book on New Guinea birds, was thunderstruck.

"Bruce looked at me and said 'Are you telling me you've found a *poisonous* bird?'" recalls Dumbacher, his dark eyes gleaming behind small wire-rimmed glasses. "Then he said, 'This should



CRESTED PITOHIU (*PITOHIU CRISTATUS*)
CARRY LOW LEVELS OF TOXICITY.

be on the cover of *Science*! Turn the car around! We're going back to town to get permission to study this bird!"



In the eight years since Jack Dumbacher—now a research associate at the National Zoo's Conservation and Research Center in Front Royal, Virginia—first published his controversial discovery in *Science*, one of the world's most prestigious scientific journals, his life and work have been largely overtaken by this small, spunky bird. Dumbacher's research has not only shown that some birds may use toxins for defense, but changed the way people think about the biology of New Guinea. It also launched a scientific quest over several continents to find answers to the hooded pitohui's noxious



LEAF INSECT (*PHYLLIUM* SP.) FROM PAPUA NEW GUINEA.

mysteries. What is staggering to Beehler and many other scientists about this discovery is that pitohuis have been known to science for more than 100 years and live only a few miles from New Guinea's bustling capital, Port Moresby.

"It was right there under our noses," Beehler admits, as he relaxes in his office at Conservation International, where he is a senior representative for Melanesia. "Pitohuis are New Guinea's most common, widespread bird. They've been collected by scores of expeditions. Museums around the world are filled with pitohuis. And yet nobody knew they were toxic. That really says how much we don't know about what's going on out there."

Unraveling the pitohuis' strange biology has been as difficult and frustrating for Dumbacher as freeing them from his nets. When he first returned to the U.S. in 1990 with the bird's spicy feathers in hand, Dumbacher searched for a skilled chemist who could help him identify what kind of toxins the feathers carried. But few took the young grad student seriously: No one really believed that poisonous birds might exist. As months passed, Dumbacher began losing hope of ever finding the answer to the pitohuis' riddle.

One day his luck finally changed. A herpetologist referred Dumbacher to John Daly, a pioneer in pharmacology at the National Institutes of Health (NIH) who had done groundbreaking research on South American dart-poison frogs. It proved to be a fateful introduction. During the 1960s and 1970s, Daly

spent years in both the lab and the tropical forests of South America studying the tiny, brilliantly colored frogs that the Choco Indians of western Colombia used to poison the darts of their blowguns. After years of research Daly

and his colleagues showed that these frogs secreted a powerful collection of neurotoxins from glands on their backs. These deadly species,

including a bright yellow frog the researchers aptly named *Phylllobates terribilis*, were armed with three unique steroidal alkaloids, called batrachotoxins (BTX), in concentrations so powerful that an amount equivalent to a few grains of salt would be lethal to a person who ate it.

Widely considered one of the most deadly toxins, BTX stops all electrical impulses in muscles and nerves, causing cardiac arrest almost immediately. The poison had never been found before in any organism, and for decades Daly toiled over this phenomenon, trying to figure out how the frogs were producing it, and why. But in the mid-1980s Colombia's political climate shifted, and foreign scientists found it nearly impossible to get permission to work in its forests. As a result, all further field research into the origin of the Colombian frog's poison became impossible.

But then Dumbacher's hooded pitohui feathers floated across Daly's lab desk. Initially the grizzled scientist was skeptical. He performed some routine tests, making a crude extract of the feather's chemical and injecting it into a mouse. Within minutes the animal was dead.

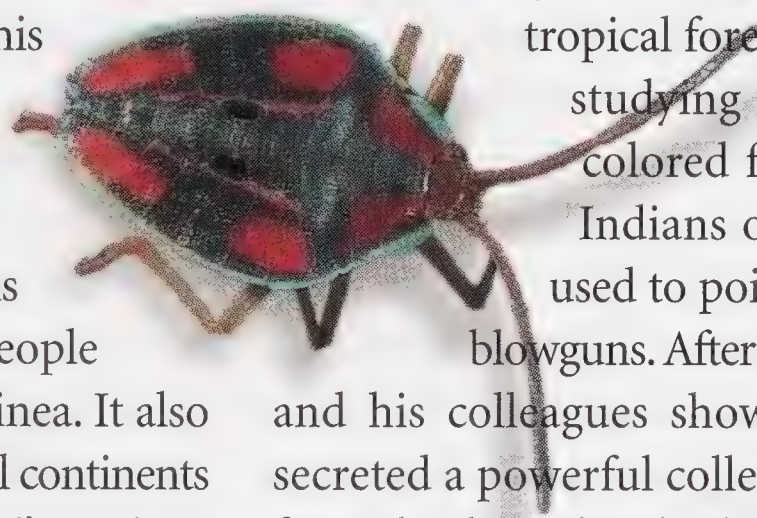
"I got this call from him, and he was really excited," Dumbacher remembers. "He said, 'Jack! You've got to send me more of those feathers! There is something extremely toxic in there!'" Daly analyzed the pitohui's feathers, skin, and internal organs, using chromatography to identify extracts of the chemical. The tests detected the presence of batrachotoxins—the exact same compounds that Daly had found in the frogs.

"It was totally unexpected," says Daly. "It's just very fortunate Jack sent the samples to us, because anybody else might have struggled over it for years."

But what was a bird in New Guinea doing with lethal poisons only found—so far as we know—in frogs from the other side of the world? And why wasn't Jack Dumbacher dead from tasting them?



New Guinea rises out of the sea about 100 miles north of Australia, with jagged, tree-covered mountains that disappear thousands of feet up



“The next time we caught a hooded pitohui,” he remembers, “I just plucked one of the feathers and tasted it: *Whammo!* Whatever it was, it was definitely in the feathers.”

into a nearly perpetual mist. Millions of years ago it separated from the mainland; and native animals, like birds of paradise [see sidebar, page 19] and pitohuis, fol-

lowed their own evolutionary paths. To foreigners, the island can seem ancient and magical, like a world lost in time. But to Jack Dumbacher and his team, it's a wonderland of biological mysteries.

Soon after Dumbacher's discovery was published, he trekked back into New Guinea's interior forests to find why hooded pitohuis were poisonous. From the start it was obvious something complex was going on. Hooded pitohuis from some regions of the island were found to be much less poisonous than those from other regions. Tests on three other pitohui species—the rusty (*Pitohui ferrugineus*), the black (*P. nigrescens*), and the variable (*P. kirhocephalus*)—showed that they too were toxic, but not at the levels of the hooded pitohui. In Varirata National Park alone, Dumbacher found hooded pitohuis so full of BTX that simply holding them made him sneeze and his eyes water. But, a

few miles to the north, the same species were almost non-toxic. To the biologists this indicated that the birds' poisons were not inherited, but rather acquired, or *sequestered*, probably from something they were eating. But proving this hypothesis has been daunting.

“It's like looking for a needle in a haystack,” Beehler explains. “New Guinea has about 700,000 species of insects and maybe 15,000 plant species. The toxin source may only be from one organism, at one particular time of year.”

Years before, John Daly had brought some dart-poison frogs back to his NIH lab in Bethesda, Maryland, for study. He fed them a lab diet of non-toxic termites, and to his amazement,

the next generation of frogs hatched in the lab was completely non-toxic. When the frogs matured, Daly fed them small amounts of BTX. In no time the toxin began accumulating in their skin, strongly indicating that the source of the frog's poison came from an unnamed insect living deep in the Colombian rainforest.

Dumbacher wants to do a similar experiment with the hooded pitohuis, and has a tentative agreement with the government of New Guinea to bring several birds to the National Zoo this year. If the pitohuis lose their poison it will be hard evidence that they have a very toxic diet back home. But what? Dumbacher and his team suspect some kind of insect is making the birds

poisonous, and they have been examining every bug pitohuis are known to eat. But so far none has come up positive for BTX.

In fact, the idea that an insect either

produces or sequesters BTX at all is controversial. Many scientists think that insects aren't the only suspects in this biological detective story. Some have suggested pitohuis may get their poisons from bacteria, or that BTX is somehow assembled in their bodies from more than one plant or insect they are eating, each providing a vital chemical component. Todd Capson, an independent ethnobiologist at the Smithsonian Tropical Research Institute in Panama, is heading for New Guinea this year to mount his own search for pitohui poison. For him the evidence points to a complex process in which BTX is transferred from prey to predator up the food chain to pitohuis.

“If I was a betting man, I'd bet that a plant makes it in the beginning,” Capson says, “and that plant is then eaten by an insect, which is then eaten by pitohuis. My personal guess is that the insect is a weevil, because weevils are everywhere

and they are known to eat every part of plants.”

Even so, Beehler says looking for the source of pitohui BTX by traditional scientific methods, such as by examining the droppings and stomach contents of these birds and watching what they eat, is not the only—or most efficient—way to find the answer. Native Papuan tribes have been observing nature on the island for possibly 50,000 years or more, and their oral traditions of medicine and magic reveal a vast collection of biological knowledge. When he returns to the New Guinea wilds, Capson plans to seek out local village elders and “wily old men” who may be able to provide clues to which local plants or animals may be poisonous.



BLUE-CAPPED IFRITAS (*IFRITA KOWALDI*) CAN ALSO CARRY BTX TOXINS IN THEIR FEATHERS.

Local Papuans provided vital insights for Jack Dumbacher almost from the beginning of his adventure with the pitohuis. In 1990 when he first realized pitohui feathers might be toxic, a co-worker mentioned that she had read about these birds being bitter to the taste in an old book. Dumbacher looked up the book, *Birds of My Kalam Country*, which was a compilation of local Kalam tribal wisdom on highland birds, written in 1977 by the New Zealand anthropologist Ralph Bulmer and his Kalam colleague Ian Saem Majnep. In the book, Dumbacher discovered a description of the *wobob* (the hooded pitohui) that reported, "...some men say the skin is bitter and puckers the mouth...."

The book also gave a similarly tantalizing account of the blue-capped ifrita (*Ifrita kowaldi*), an apparently unrelated bird half the size of a pitohui that lives in the high mountains. Its Kalam name, *slek-yakt*, literally means "bitter bird," the authors write, "because if it is not skinned before eating some men find that it burns their mouths, making their lips sore and puckered."

In 1993 Dumbacher traveled by light plane up into the highlands to the Kaironk Valley, a remote region in the southwestern corner of Mandang Province where Saem Majnep and his Kalam people still live. Majnep had little formal Western education, but among his people he was regarded as a man deeply learned in traditional wisdom. His knowledge of the plants and animals of the highlands had impressed Bulmer so much that he asked Majnep to collaborate on his book on Kalam bird lore. In their paragraph on the pitohui, Majnep also included Papuan folklore about how the *wobob* bird was often evoked in Kalam war-magic spells because it dodges around like a man avoiding arrows, and how the word *wobob* itself refers to a kind of skin disease that is uncomfortable and itchy. While such descriptions may at first seem

more like myth than science, Dumbacher points out that if one listens carefully, one may discover valuable information.

"The Bonua people of Central Province told me they knew the pitohuis were poisonous, but that if you kill one and want to eat it, what you have to do is mourn for it," he recalls. "If you mourn for it long enough and sincerely enough, then you can eat it and it won't make you sick. But they said they usually don't eat the birds because you never know if

This process would render the bird safe to eat.

Majnep gave Dumbacher vital clues about the blue-capped ifrita as well, and had his hunters collect some specimens. Small and brown with a bright blue crest, the ifrita behaves like a nuthatch, foraging for insects among the trees of the highland cloud forests more than 12,000 feet above sea level. Everything about it is different from a pitohui, except for one thing.

"We were with the local guys," Dumbacher remembers. "I was examining an ifrita and was

about to taste one of its feathers, when the locals started shouting 'No!!! Don't do that!!' They were absolutely convinced I would die if I tasted it."

When the results came back from NIH on the ifrita's skin and feathers, they showed nearly identical profiles of BTX alkaloids for both birds. Dumbacher also found ifrita farther to the east, in the Finisterre mountain range of the Huon Peninsula. In the Kaironk Valley, ifrita were loaded with BTX, but here they appeared uniformly non-toxic. Clearly this bird was also getting its poisons from a food source. Now Dumbacher had an even bigger mystery: two apparently unrelated birds, living in two very different regions of New Guinea, yet both



NEW GUINEA'S COMPLEX TOPOGRAPHY HAS ISOLATED HUNDREDS OF UNIQUE HUMAN SOCIETIES. EACH SOCIETY HAS AMASSED TREMENDOUS KNOWLEDGE OF THEIR ENVIRONMENT THAT WESTERN SCIENTISTS ARE ONLY BEGINNING TO RECORD AND STUDY.

you've mourned enough."

What stories like this reveal, says Dumbacher, is that the Bonua knew that some pitohuis are more toxic than others, but that in general they should be avoided. Todd Capson also found important biochemical information about pitohuis from listening to local hunters. They told him that the only way to eat a pitohui is to strip off its feathers and skin and then smear charcoal all over its meat before roasting it.

"To most people this sounds weird," says Capson, "but to an organic chemist what they are doing is removing the toxin, because charcoal is well known for its ability to adsorb, or adhere to, organic compounds like homobatrachotoxin."

using the same spectrum of toxins. This indicated that the use of BTX among the island's birds was more than a single freak event of evolution. Something much more complex was at work in these forests.



In 1941 British ornithologist Hugh Cott was on military leave in the Egyptian city of Beni Suef, doing what he enjoyed most: studying birds. He was preparing some specimens for mounting and had left the skinned carcasses of a palm dove (*Streptopelia senegalensis aegyptica*) and a pied kingfisher (*Ceryle rudis rudis*) lying nearby on the grass. Then Cott noticed something odd:

Though not poisonous, Raggiana birds of paradise (*Paradisaea raggiana*) and magnificent birds of paradise (*Cicinnurus magnificus*)—which each share habitat with pitohuis on the island of New Guinea—exhibit some interesting habits of their own. Known for loud and complex calls, the bird of paradise family, Paradisaeidae, contains both monogamous and polygamous species. The males of the monogamous species are homebodies, generally dressing in dull shades and sharing in the rearing of young. Males of the polygamous species, including the Raggiana and the magnificent, live a little more wildly. They are well known for their beautiful plumages, elaborate courtship displays, and labored undulating flight—a testament to their dignified choice of beauty over speed and function.

During their mating seasons, these colorful males faithfully attend leks: communal perches where they display, dance, sing, and do just about whatever it takes to attract that special someone. But they offer no help when females have to raise offspring. In both the monogamous and polygamous species, females are drably colored, generally selecting only from the brown section of the feather fashion closet.

Male Raggiana birds of paradise work hard to find a companion. After sparring for a spot on the lek with three to six other birds, they hoot and holler and display, hoping to scare off other males and attract females. Once a female lands on a male's perch, he begins his best display. He leans forward until his body is nearly inverted: tail up, head down. He then extends and clasps his wings overhead so the female has a clear view of his brilliant and fully displayed plumage. During this exhausting maneuver, the Raggiana female casually sits in front of or beside him, reaches in under the extended wings, and pecks at his beak. After mating, the female quickly flies off and the male resumes his display, searching for his next mate.

The female magnificent bird of paradise expects even more out of her male when he's putting on the moves.

Males first begin their rituals by using their beaks to clear twigs from the forest floor and remove leaves from overhanging branches, so that sunlight can shine on their iridescent feathers. A researcher once observed a male

removing twigs so industriously that he paid no attention to a female that landed a few feet away.

Once on the lek, male magnificent birds of paradise also coo and whistle at passing females. Their displays generally consist of five parts. With females flying nearby, the male begins his back display—similar to the Raggiana display—where his body is inverted with tail up so his tail wires and bright colors are fully exposed. The male then usually begins raising and lowering his breast. Once a female lands on his perch, the male gets a little fired up. He begins with the horizontal display—his torso held rigid and horizontal while he bounces his entire body and serenades his date with low chirruping notes that grow with agitation as she approaches. With one swift movement, he transitions to the cape display, neck extended, yellow cape exposed. If he still has his audience captivated (or at least in attendance), the male magnificent eases into the very elaborate



MALE RAGGIANA BIRD OF PARADISE.

LEKKING FOR A GOOD TIME

BY MATTHEW HUY

dancing display, usually a prelude to mating. Being very excited, he pulsates his breast feathers, opens and closes his beak, bobs his head side-to-side, quivers his tail wires, and dances up and down the perch in short, jerky movements, all the while emitting a low, harsh buzzing song. After mating, the female then flies away. In both the Raggiana and magnificent species, the female alone constructs the nest, rears one to two chicks, and sends them on their way after three to four weeks.

The Smithsonian's National Zoo recently acquired two female Raggiana birds of paradise and one female magnificent bird of paradise, now on exhibit inside the Bird House. And keep an eye out, for the Zoo is making arrangements for a male magnificent bird of paradise to fly into town this spring.

It surprised me to read in the accompanying article that quail were toxic. I had roasted a few just the other night and served the tasty little birds with a nice spicy blackberry sauce and a little wild rice. So, being more than a little skeptical, I started checking this story out. It turns out that yes, indeed, wild quail can be poisonous—but not all quail and not all the time and not in all places. The poison quail tale is like a murder mystery, complete with an enigmatic weapon, an attractive peripatetic killer, and victims who ought to know better.

Widely distributed in the Old World, there are eight species of *Coturnix* quail. Common or European quail (*Coturnix coturnix*) are charming creatures with mottled russet plumage, short legs, and short tails. Six or seven inches tall, these rotund birds weigh just about five and one-half ounces. They feed on seeds of grasses, weeds, and grain from as many as 100 plant species, as well as eating insects and spiders.

These quail migrate between the cold northern reaches of Europe and sub-Saharan Africa. Their migratory patterns are complex and poorly understood. But in general the quail travel north toward Europe from late winter through spring, breed from late spring to the end of the summer, then return south to Africa. From North Africa through Europe, hunters pick off the birds in droves, although smaller droves than in the past due to overhunting and changing agricultural practices. Some of the people who eat the delicious game birds get sick from a toxin in the quails' fat and flesh.

But there are several puzzling phenomena here, according to a detailed review by Louis Grivetti, a nutritional geographer at the University of California at Davis. Members of the other quail species, including the African subspecies of the common quail (*C. c. africana*), are not known to be toxic. European quail are toxic only while migrating, and even then, only some of the birds, some of the time. Quail using the eastern migratory flyway are toxic only during the southern, fall migration, while quail using the western flyway are toxic only during the northern, spring migration. There is also a strange patchy distribution of human poisonings, with cases reported from northern Algeria, southern France, mainland and island Greece, northeastern Turkey, and southwest Russia. Some people appear not to be affected by the toxin; there is a report of four people sharing a pot of quail soup and only one getting sick. Scientists suggest a genetic susceptibility to whatever the toxin is. Finally, scientists sensibly ask, why do people in these areas continue to eat the birds, knowing they might be poisoned, and even eat them again after recovering? (There



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QUAILING FROM QUAIL

BY SUSAN LUMPKIN

may never be a satisfying scientific explanation for human imprudence, however.)

The medical term for the effects of eating toxic quail is coturnism. The illness sounds dreadful, with a list of symptoms that includes vomiting, respiratory distress, excruciating pain, and paralysis, but it is seldom fatal except to elderly people. Conversely, children are said to get less severely sick than adults. But it takes from three to ten nasty days to get over the

symptoms. Yet come next year, many victims willingly partake of the succulent dark meat.

The name coturnism wasn't coined until this century, but people have known about quail poisoning for perhaps as long as 3,500 years. This estimate is based on a Biblical story of Israelites in the wilderness feasting on quail and quickly being struck down with a plague. Later, ancient Greek and Roman writers described the syndrome as well. From then until fairly recently, it was generally believed that the birds' toxicity derived from their eating poison hemlock (*Conium maculatum*) seeds during migration.

Two types of evidence have cast doubt on this idea. First, in experimental trials conducted by Grivetti and his students, Asiatic quails (*Coturnix japonica*) fed hemlock seeds sickened and died. Second, hemlock is not in seed when western flyway quail are toxic in North Africa, but is in seed when quail are safe to eat. On the other hand, Grivetti notes that the quail might obtain coniines (the toxic compound in hemlock) from a plant other than hemlock. Or, Asiatic quail may be more sensitive to coniines than the European form, although the two species are very closely related.

Other possible culprits include a botulism-like neurotoxin and aristolochic acid, an acid that occurs in some insects quail are reputed to eat. Grivetti is skeptical about the aristolochic acid, however, as Asiatic quails fed this compound also die. A more likely suspect is the seeds of a member of the mint family, *Stachys annua*. Russian scientists found these seeds in the digestive tracts of quail that caused coturnism and, just as important, this plant sets seed in the various parts of its range at the same time the quail are toxic. Definitive experiments have yet to be conducted, however.

Answers to any of the other questions about coturnism remain elusive as well, and with the numbers of European quail dwindling, the syndrome might well disappear before we ever solve the mystery. But American gourmands needn't worry: The birds we purchase in the supermarket or order in fine restaurants are safe domestic Japanese quail. And very tasty indeed.

Hornets, which love fresh meat, were feasting energetically on the dove, but had left the kingfisher conspicuously untouched. Intrigued, Cott decided to test the palatability of kingfishers and other birds' flesh, first on hornets and then on cats and humans. Cott's research eventually led him to conduct extensive studies that not only showed that some bird species tasted bad, but also a possible reason why.

"What he found was that the more vulnerable a bird was, the nastier it tasted," says Harvard anthropologist Richard Wrangham. "He defined 'vulnerability' as being brightly colored or slow moving or the like. He also found that across Europe, Africa, and North America black birds generally taste bad as well. So the old refrain about 'eating crow' holds true."

Recent studies have suggested that many birds may be using some kind of chemical weaponry as defense, much like insects and amphibians. Ocean-going fulmars spit noxious stomach oils to drive away predators, some species of grackle give off a terrible odor when threatened, and many passerine birds, of which pitohuis and ifrita are members, have been known to smear their feathers with ants, apparently to repel parasites. Some birds, like the Eurasian quail (*Coturnix coturnix*), the spur-winged goose (*Plectropterus gambensis*), and the African olive-pigeon (*Columba arquatrix*), are suspected of being toxic as a result of eating poisonous insects and plants [see "Quailing from Quail," page 20]. Two species of Australian bronzewing (*Phaps* sp.) may even be sequestering the lethal toxin fluoroacetate, more commonly known as "1080," a poison that occurs naturally in their diet of heartleaf (*Gastrolobium bilobum*). But no one knew exactly which chemicals were being used.

"The pitohuis and the ifrita are the first examples of birds that use an identified toxin as part of their defense strategy," says Cornell chemical ecologist Thomas Eisner. "That discovery changed everything about how we think about birds."

Where Papuan birds and Colombian frogs diverge, Eisner says, is in the way they use their

poisons. The tiny frogs store highly concentrated BTX alkaloids in glands on their backs, so that when they are threatened they secrete almost pure toxin. The pitohui and the ifrita, on the other hand, seem to have BTX in their dander, which diffuses all over their bodies, making the birds poisonous but not necessarily lethal. In fact, Dumbacher noticed that the greatest levels of BTX were found on the birds' breasts and underside, suggesting that their eggs and nests may also be infused with BTX. This would be a particularly effective defense against snakes, which Dumbacher sees as a likely pitohui predator. Snakes hunt birds in their nests at night, and tend to taste with their tongues before striking. One

bird species are known to forage together in the island's swampy lowlands. Usually these flocks are led by members of at least three of the toxic pitohui species, suggesting a highly complex social defense system among New Guinea's birds. Writing in the British journal *Nature* shortly after Dumbacher's initial discovery, Diamond even proposed that birds of paradise might also be distasteful.

"At least 15 species of birds of paradise join the pitohui flocks," he says, "and the taste of birds of paradise has been reported as: 'the most shocking flesh I have ever eaten...bitter as gall...truly abominable.' So interactions with poisonous brown and black birds may have a long-

standing selective force on birds of paradise."

Right now, however, the only thing that has been shown about pitohuis and ifrita is that they use BTX, and that it appears to repel some of

"The Bonua people of Central Province told me they knew the pitohuis were poisonous, but that if you kill one and want to eat it, what you have to do is mourn for it."

their parasites. Whether the birds use BTX for defense, where it comes from, and how they are able to withstand its effects are questions that remain tantalizingly unanswered. Jack Dumbacher and his team plan to return to New Guinea's Varirata National Park to continue the search, looking for pitohui nests, fitting birds with radio collars to track their feeding habits, and sending new batches of suspicious bugs back to Daly at NIH for analysis. Coupled with information from Capson and Majnep, Dumbacher hopes that his project will answer some of the questions his research has raised. But the process could take years. For scientists like Jack Dumbacher, that's all part of the allure of New Guinea's biological *terra incognita*.

quick flick of a serpent's tongue might instantly tell it that pitohuis and ifrita were too risky to eat. Dumbacher thinks BTX might even act as a natural bug repellent, driving off hungry lice and mosquitoes.

Critics of Dumbacher's ideas say that his team is placing too much emphasis on the fact that these birds are toxic, not noticing the possible cocktail of other repellent chemicals at play in both species. Todd Capson disagrees.

"There is a real advantage to being able to use and sequester homobatrachotoxin," he explains. "Not only is it very effective at protecting these birds against predators, but it also guarantees them an exclusive food source because they can eat bugs with this toxin that nothing else can."

In many cases predators wouldn't have to get close enough to taste these birds, or get a whiff of their distinctive smell. Like monarch butterflies and gila monsters, pitohuis are bright orange and black, a color-coded warning that tells predators they are poisonous. Pitohuis of both sexes are equally toxic and colorful, a signal that may play a larger role in the New Guinea ecosystem. According to University of California at Los Angeles writer, physiologist, and naturalist Jared Diamond, large flocks of several brown and black

bird species are known to forage together in the island's swampy lowlands. Usually these flocks are led by members of at least three of the toxic pitohui species, suggesting a highly complex social defense system among New Guinea's birds. Writing in the British journal *Nature* shortly after Dumbacher's initial discovery, Diamond even proposed that birds of paradise might also be distasteful.

"Almost nothing has been studied there," says Dumbacher, "so you can stumble across tree kangaroos and poisonous birds—all kinds of weird things. I've always tried to let the animals tell me where to look and what to study. In a place like New Guinea, nature is way ahead of our imagination." Z

—John Tidwell, a freelance writer and independent television producer, last wrote about parrot smuggling in the November/December 2000 ZooGoer.



BY JUDY MILLS

KING OF WOOL

High Fashion and the
Chiru's Shahtoosh

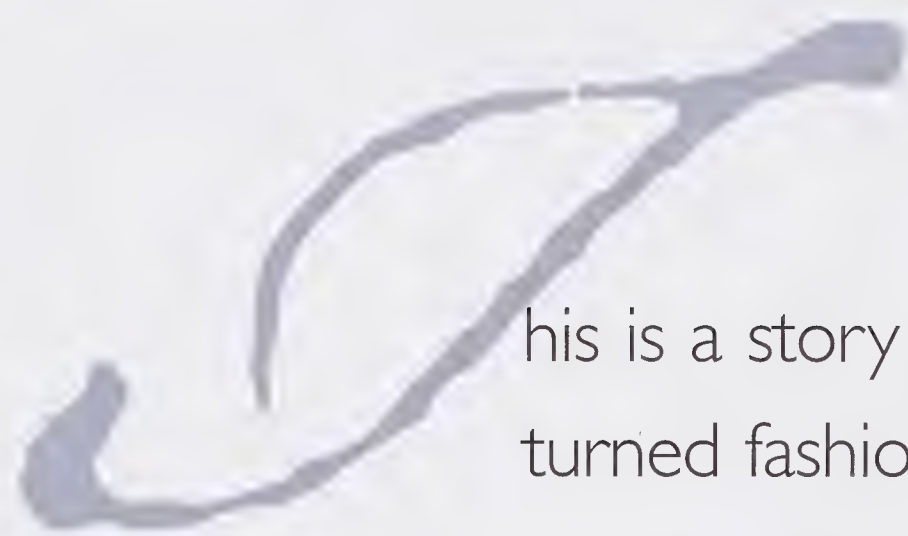




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XI ZHINONG

IN THE SHADOWS OF THE HIMILAYA, HERDS OF CHIRU, OR TIBETAN ANTELOPE, FACE A DIM FUTURE DUE TO THE CONTINUING DEMAND FOR THEIR LEGENDARY—AND ILLICIT—FUR.



his is a story of beauty turned ugly. A story of a species turned fashion victim. A story of murder and subterfuge on the roof of the world. This is the story of shahtoosh.

or chiru (*Pantholops hodgsoni*), contains some of the world's finest hair, measur-

Roughly translated from Persian, shahtoosh is understood to mean the "king of wools." The description is no hyperbole. Shahtoosh is gossamer in weight and texture, soft as a baby's skin, yet warm. Scarves and shawls made of

ing three-quarters the width of cashmere and one-fifth that of human hair. Shahtoosh is so fine that even a large shawl can be pulled with ease through a finger ring, giving it its other name "ring shawl."



shahtoosh come in natural beige and off-white, may be dyed rich colors, and are sometimes intricately embroidered. They sell for \$1,000 to \$5,000 and more, and have become the rage among the rich, famous, and fashionable. Movie stars wrap newborns in them, socialites drape them over ball gowns, and a Hong Kong tycoon dines with one in his lap. Shahtoosh owes its "royal" status to the hair from which it is woven. The coat of the endangered Tibetan antelope,

Behind this luxury lies death: Three to five chiru must die to provide the ten to 20 ounces of raw wool needed to produce a single shawl, according to the Wildlife Protection Society of India. Poachers are gunning down chiru in droves for the sake of this fashion craze. William Bleisch of the China Exploration and Research Society (CERS) reported that, in the summer of 1999, he personally saw more than 900 skinned chiru carcasses—many of them

pregnant females—in China's high-desert Arjin Shan Reserve.

Shahtoosh's Roots

Chiru are virtually exclusive to the Tibetan Plateau in Tibet and adjoining areas of China, although they occasionally wander into India's Ladakh region. Since 1979, chiru have been listed on Appendix I of the Convention on

and Kashmir, which is afforded special status under India's constitution. However, good news for chiru came in October 2000 when Jammu and Kashmir agreed to phase out and eventually ban all trade in shahtoosh.

Shahtoosh shawls crafted by Kashmiri weavers have been dowry items in northern India for centuries, and it is possible that this level of demand posed little threat to the chiru's survival.

by the eminent field biologist George Schaller of the Wildlife Conservation Society (WCS), who estimated in his 1998 book, *Wildlife of the Tibetan Steppe*, that "tens of thousands of animals must have been killed" to supply the trade during that time.

In 1900, the chiru population may have numbered one million. In a report issued in December 1998, China's State Forestry Administration (SFA) cited Schaller's estimate that fewer than 75,000 chiru remained in the wild in 1995. Based on confiscated chiru pelts and wool, along with discarded chiru carcasses found by CERS and government officials, SFA estimates that 20,000 chiru now fall victim to poaching each year.

Shoot-Out on China's High Plains

The world's growing demand for shahtoosh has left a trail of bloodshed. From 1990 through 1998, Chinese authorities documented 100 cases of chiru poaching. They confiscated 17,000 chiru pelts and about 2,400 pounds of chiru wool, as well as 300 guns and 153 vehicles used by poachers. Some 3,000 people were arrested and at least three poachers shot dead. Between December 1999 and February 2000, another 1,539



THREE TO FIVE WILD CHIRU MUST BE KILLED TO PRODUCE A SINGLE SHAHTOOSH SHAWL.

International Trade in Endangered Species of Wild Fauna and Flora (CITES), thereby banning chiru and their parts and derivatives from international trade. The People's Republic of China gives them the highest level of legal protection under its Wildlife Protection Law, prohibiting chiru hunting and trade in chiru parts without government permission. Chiru trade also is prohibited in India under the Indian Wildlife (Protection) Act, except in the state of Jammu

What set the animal on the path to extinction was its elevation from dowry treasure in India to must-have accessory in world fashion centers. How this fad started is unclear. What is certain is that, at its current level, the shahtoosh craze drives a trade that the chiru cannot sustain.

Despite legal protection and trade bans, the burgeoning Western market for shahtoosh caused a dramatic increase in chiru poaching in the late 1980s and early 1990s—a connection first noted

pelts were seized, along with rifles, ammunition, and vehicles.

In many instances, anti-poaching teams were outnumbered and outgunned by packs of poachers with more sophisticated weapons and better vehicles. Soinam Darje, who headed an anti-poaching patrol credited with many arrests, became a national hero in China when he was killed in a gunfight with poachers in January 1994. At least one other government official



trying to save chiru from poachers has been killed in action.

TRAFFIC, the global wildlife-trade monitoring program of World Wildlife Fund and the World Conservation Union, continues

to investigate the chiru trade. In the late 1990s, TRAFFIC India confirmed that, where chiru wool is concerned, all smuggling routes lead to the famed weavers in the Indian state of Jammu and Kashmir. Some routes take the wool from the high plains of China directly over mountain passes and into Kashmir, while others cross Nepal and go through various Indian states before arriving in Kashmir. More recently, smugglers were detouring through other parts of China, such as Sichuan Province, to avoid increased law enforcement efforts.

The wool travels by horseback, truck, train, and airplane. It may be hidden in shipments of wool from domestic animals, including angora wool and cashmere (also known as pashmina), a near-equivalent of shahtoosh [see "What's In a Name?" on page 30]. The contraband is sometimes stuffed inside jackets and blankets. At the lowest and only driveable pass between China and Nepal, customs officials in 1998 found a cache of about 480 pounds of chiru wool behind a false ceiling in a truck carrying sheep's wool.

From Weaver to Merchant to the World

Kashmiri weavers are famous for working the finest of fabrics—from pashmina and silk to shahtoosh—into intricate weaves with superior finishing. Because Jammu and Kashmir has been, until the newly announced ban, the only state in India to allow trade in shahtoosh, the weavers themselves have broken no laws. The violators are those who supply the chiru wool from China and those who export finished shahtoosh from Kashmir.

Shahtoosh shawls leave Kashmir via road, rail, and air for Delhi and Punjab. (Sources told TRAFFIC India that roads are considered the safest mode of travel for smuggling.) From Delhi and Punjab, traders distribute shahtoosh to the world.

In mid-1999, a CITES mission visited Nepal and India in order to better understand the status of tiger conservation and trade. While

Roughly translated from Persian to mean the "king of wool" in hyperbole. Shahtoosh is gossamer soft as a baby's skin.

browsing in a hotel gift shop in Kathmandu, Nepal, mission members were offered shahtoosh shawls for \$1,000 each. A TRAFFIC India investigator found shahtoosh shawls for sale in Kathmandu and Pokhara (a city in Nepal much visited by tourists), priced from \$1,400 to \$1,900.

In Delhi, the CITES mission was offered shahtoosh shawls by several traders in shopping arcades within five-star hotels. One establishment brought out dozens of shahtoosh shawls in a variety of sizes and colors, with prices starting at \$1,000. Manoj Misra, director of TRAFFIC India, estimates there are 2,000 shahtoosh shawls for sale in Delhi on any given day.

Informants tell TRAFFIC that shahtoosh buyers from around the world regularly fly to Delhi for private showings or to patronize shops in upscale hotels. Shahtoosh then makes its way from Delhi to the fashion capitals of the world in personal luggage, by courier, hidden in cargo, and by mail. Informants say that buyers from Europe, especially France, Italy, and Spain, are the most avid, although New York and Hong Kong are also hot markets.

In the first three months of 1999 alone, Delhi officials seized 290 shahtoosh shawls. A similar rate of seizures continued through 2000. Given the ease with which the light, thin shawls can be stowed and hidden among legal goods, it is logical to assume that these seizures are the mere tip of an iceberg of illegal trade.

The Hong Kong Connection

Hong Kong serves as a case study for the consumer end of the shahtoosh trade. By the mid-1990s, the rich women of Hong Kong known as "tai-tais" were hosting home sales and private showings of shahtoosh. These sales were not by any means covert. Despite the longstanding trade ban, Hong Kong's elite were not the least bit furtive about their passion for shahtoosh. In December 1997, in an article headlined "Christmas wrapping," the *South China Morning Post* reported: "...some tai-tais are known to have a collection of at least 30 to 40 [shahtoosh items]

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s.” The description is no
mer in weight and texture,
kin, yet warm.

in different colours...a devotee [pictured], has even arranged...with some of her friends... to fly to New Delhi for a shahtoosh shopping trip.”

Not that Hong Kong wildlife officials weren’t trying to crack down on the shahtoosh trade. In 1995, they seized 100 shawls from a socialite. However, the socialite’s lawyers dissuaded the government from prosecution, arguing that any case would fail in court because there was no way to prove that the shawls were made from the hair of an endangered species. Months later, the Hong Kong government returned the shawls to their owner and dropped the case.

Afterwards, the shahtoosh trade grew ever more blatant in Hong Kong. Two years after the failed case, a boutique in the territory’s Central District displayed shahtoosh shawls in its window, complete with a sign touting the illegal goods.

Some shahtoosh traders claim that their shawls are made from the down of a (non-existent) “toosh” bird. Others tell of a bucolic world where nomadic shepherds follow chiru herds, plucking their precious hairs from the bushes they brush against while grazing. Anyone who has seen pictures of the Tibetan Plateau knows there are no such bushes. Nor can chiru be shorn or plucked. This very wild and shy animal must be killed to obtain its hair. In many cases, poachers use automatic weapons to gun down whole chiru herds. Other animals die singly, caught in leg-hold traps.

Some shahtoosh aficionados claim chiru are killed because their horns are used in traditional Chinese medicine, their wool being a mere byproduct. The truth is precisely the opposite. According to SFA’s 1998 report, “The purpose of the Tibetan antelope poaching is for its wool. Up to now, all arrested poachers have confessed to it...Discarded carcasses, together with horns, are seen on all

poaching sites...” On the other hand, chiru horns are indeed sold in China, mainly for ornamental purposes. Their low cost and abundance attest to the relentless

poaching of chiru for shahtoosh.

Gradually, shahtoosh buyers have been learning the truth. By late 1996, the Hong Kong-based TRAFFIC East Asia began receiving tips about when and where shahtoosh was being sold. Some information came from shahtoosh owners wishing to make amends for their purchases. Callers told of the whereabouts of private shahtoosh sales, or shops selling shahtoosh. Hong Kong authorities promised to act on these tips, provided that TRAFFIC helped them find a method to prove that a given shahtoosh item came from chiru. TRAFFIC East Asia found that method at the U.S. Government’s National Fish & Wildlife Forensics Laboratory.

The Court Case that Turned the Tide

By 1997, the blatantly illegal trade in shahtoosh was rampant. Some companies were even selling shahtoosh on their Internet sites. Unfortunately, the whole world seemed to be paralyzed by the same weak point in law enforcement: How could prosecutors prove in a court of law that a shahtoosh shawl derived from this particular endangered species?

A case that at last answered that question began in December 1997.

Acting on a tip given to TRAFFIC East Asia, Hong Kong Agriculture and Fisheries Department officers raided a private exhibi-

tion at the Furama Hotel, seizing 130 shahtoosh shawls there and 10 others from the exhibitor’s shop. Raids on three other shops resulted in the confiscation of an additional 46 shawls. The first 140 shawls became the foundation of *Hong Kong v. Assomull*, which may go down in history as the case that closed the shahtoosh loophole.



XI ZHINONG

BORN IN JUNE OR JULY, ONLY A THIRD OF CHIRUS SURVIVE THEIR FIRST YEAR. ADULTS MAY LIVE TO EIGHT YEARS OF AGE.

Chiru (*Pantholops hodgsoni*)

Also called Tibetan antelope, chiru resemble gazelles but are most closely related to wild goats and sheep.

DISTRIBUTION: Chiru survive on the Tibetan Plateau across Tibet and adjacent parts of China and into Ladakh in north-west India.

HABITAT: Among the world’s most cold-hardy mammals, chiru live on windswept plateau steppes at elevations from 11,000 to 18,000 feet where average annual temperatures are below freezing. Daily temperatures may drop as low as –40 degrees F. Chiru rest in shallow depressions that may offer some protection from wind and cold. Other mammals living in this habitat include wild yak, argali sheep, wild ass, and brown bear.

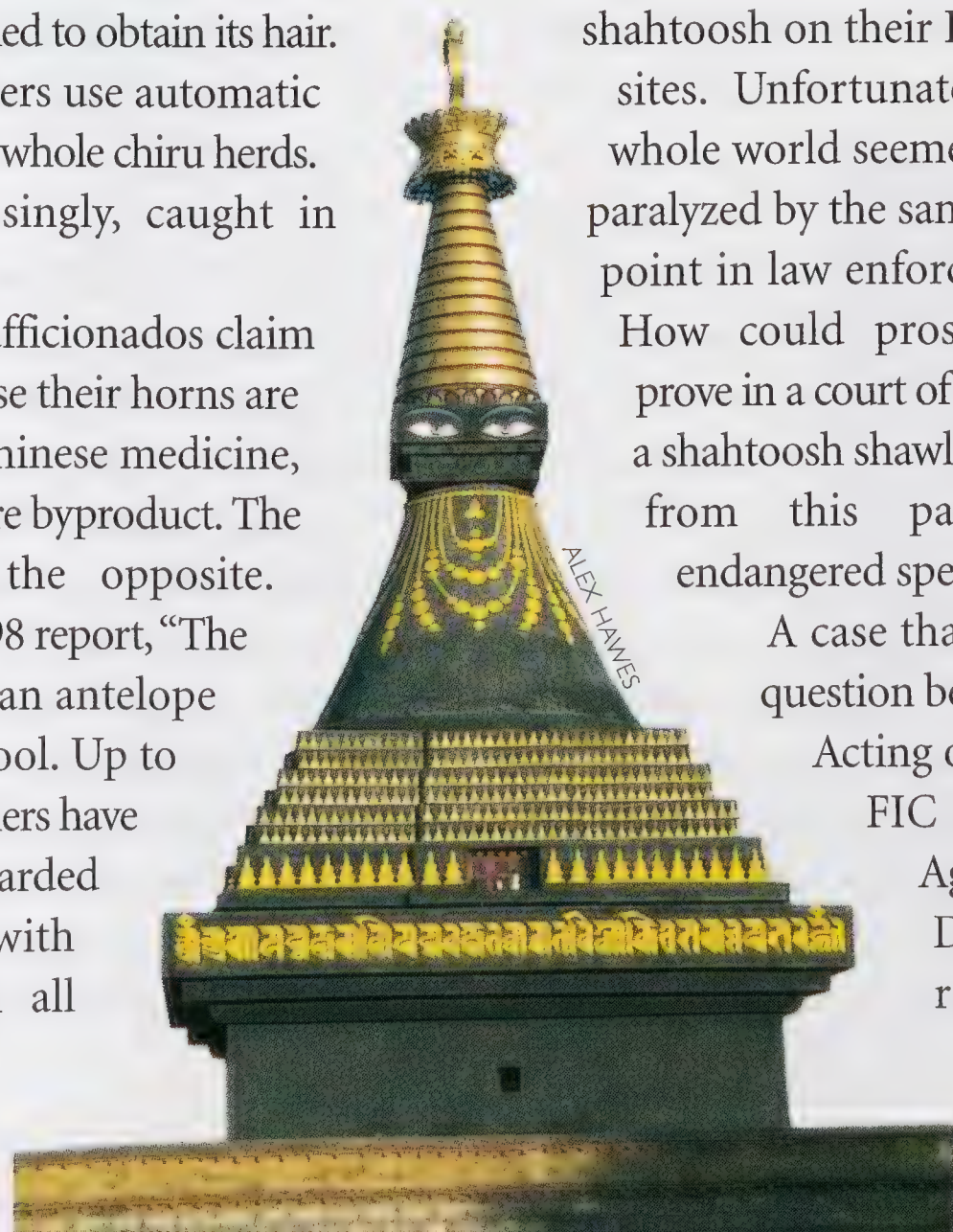
DIET: Chiru eat grasses and herbs.

SIZE: Standing less than three feet at the shoulder and stretching about four and half feet from nose to tail, chiru weigh between 55 and 100 pounds. Females are smaller and lighter than males, which sport slender, backward curving horns about 20 inches long.

REPRODUCTION: Leaving males behind, herds of females migrate to calving grounds to give birth to a single baby in June or July. Mating occurs in late November and December, when males fight—sometimes to the death—to guard harems of ten to 20 females.

LONGEVITY: Infant mortality rates seem to be quite high: As many as two-thirds of young do not survive their first year. Adults may live to eight years of age.

THREATS: Apart from rampant poaching for their exquisite wool, the chiru’s future is threatened by an influx of pastoralists and other settlers into their habitat. Livestock compete with chiru for grazing land, and fences disrupt migration. Oil drilling and gold mining pose additional problems in chiru habitat.



ALEX HAWES

In order to prepare their prosecution, the Hong Kong Government Laboratory sent a chemist to the National Fish & Wildlife Forensics Laboratory in Ashland, Oregon. Upon her return, the chemist used that lab's test to analyze the confiscated shawls and found them to contain chiru hairs. Hong Kong authorities took the additional step of flying the creator of the identification method from the United States to Hong Kong to testify.

On February 25, 1999, Hong Kong Magistrate David John Dufton convicted Bharati Ashok Assomull of possession of highly endangered species (in the form of those 140 shahtoosh shawls) without a license. Dufton was painstaking in his remarks. He called Assomull's a "very serious offense" and noted Hong Kong's "international obligations" under CITES. He said he was "satisfied" that the laboratory method used to identify the shawls as



SKULLS BEAR WITNESS TO THE RAMPANT POACHING OF ENDANGERED CHIRU.

However, halting chiru poaching is a near-impossible task. China's Arjin Shan Reserve—where Bleisch saw 900 skinned chiru in August 1999—encompasses more than 17,000

acceptable to wear shahtoosh," she wrote, "nor to claim you need one to survive." Socialite entrepreneur David Tang, who once stubbornly pledged allegiance to buying shahtoosh and likes to place a shawl on his lap at supper, publicly pronounced: "Now I will not buy any shahtoosh."

When TRAFFIC East Asia staff recently asked a seller of pashmina shawls in Hong Kong's famous Stanley Market whether she had any shahtoosh, she responded with a vehement "No!" "I used to," she added, "but I do not want to go to jail."

Hong Kong is but one market for shahtoosh. Many others, such as those in Europe, North America, and Japan, require further investigation and exposure.

At the time of this writing, the first criminal prosecution in the United States for shahtoosh trade was coming to a close. The case resulted from the sale of shahtoosh shawls to more than

"...some tai-tais are known to have a collection of at least 30 to 40 [shahtoosh items] in different colours...."

derived from chiru was "admissible" and "beyond doubt." He further commented that the Hong Kong chemist who tested the shawls was a "reliable witness" and "sufficiently skilled" to identify chiru hair. On April 13, 1999, Dufton sentenced Assomull to a three-month suspended jail term and fined her more than \$40,000. If caught selling shahtoosh within the 12 months following her sentencing, she would have been made to serve the jail sentence.

Hong Kong has successfully prosecuted two other cases of illegal shahtoosh trade to date, including one involving an Indian national selling shahtoosh from his room in one of Hong Kong's five-star hotels. Entries in his passport showed that he had been coming to Hong Kong during the same pre-Christmas period for years.

The Beginnings of a Turnaround

Since the SFA's December 1998 report, efforts by Chinese authorities to stop chiru poaching have led to at least 80 arrests, four jail sentences, and the confiscation of 1,658 chiru skins, 18 vehicles, 14 guns, and 12,000 bullets, according to government records. Two more poachers have died.

square miles. To patrol this mountainous expanse, the reserve's managers have only four vehicles. In all, the chiru roams through more than 230,000 square miles of remote high desert habitat, an area larger than France.

At the same time, about two pounds of raw chiru wool can bring a poacher the equivalent of several month's wages. Middlemen linking poachers to weavers to end-use consumers make exponentially increasing profits at each level of trade.

However, without the end-use consumer, there would be no profit to trickle down to chiru poachers for their efforts. Cutting off demand appears to be a far more feasible way of saving the chiru than stopping poaching in what one conservationist calls "the wild west at 18,000 feet."

Consumers are already showing signs of changing their minds. Dinner conversation among Hong Kong's elite is turning against the buying, selling, and wearing of shahtoosh. In 1999, one tai-tai wrote to British *Vogue* to protest a picture of Lady Charlotte Fraser wearing a shahtoosh, sarong-style, next to an article entitled "Survival Tactics." "It is neither socially

100 high-society women in New York City by a U.S. business that acted as an agent for Navarang Exports of Bombay. Navarang illegally exported 308 shahtoosh shawls to the U.S. between September 1994 and March 1995. Navarang pleaded guilty in July 2000, along with the women who own its U.S. distributor, and admitted illegally exporting nearly 100 shawls intended for sale at a boutique in Paris. Sentencing for all three parties was scheduled for November 2000, but was postponed.

The illegal trade in shahtoosh is driven by consumers. You can do your part in stopping the chiru slaughter by refusing to purchase articles made of shahtoosh. If a merchant labels an item as pashmina—the popular alternative to shahtoosh—be sure that it is what it says it is. Price is an indicator. If the item costs \$1,000 or more, it may contain shahtoosh. If you have any doubt, please do not buy. Z

—Judy Mills is a Senior Program Officer with World Wildlife Fund-U.S. Previously, she was the founding director of TRAFFIC East Asia, based in Hong Kong.

BOOKS, NATURALLY

Prodigal Summer.
Barbara Kingsolver. 2000.
HarperCollins Publishers, Inc.,
New York.
444 pp., hardbound. \$26.

Much modern environmental writing, fiction or non, is romantic, with its celebration of unspoiled nature, its appeal to the senses, and its nostalgia for the purer, wilder, real-er past that we could return to if only we would open our eyes and save our souls from modern-day devils. Its vision for the future is the past. In *Prodigal Summer*, Barbara Kingsolver seems firmly in the grip of romanticism.

Set in the forests and farms of Appalachia, its interwoven tales unfold over the course of one summer, when the very air seethes with the wanton behavior of multiplying life forms: "... prodigal summer, the season of extravagant procreation. It could wear out everything in its path with its passionate excesses, but nothing alive with wings or a heart or a seed curled into itself in the ground could resist welcoming it back when it came." For biologist Deanna Wolfe, this particular summer is all the more magical for the breeding coyotes that have moved into the mountain reserve where her job is "keeping an eye on paradise." Confident she can protect her coyotes from the shotguns of the valley's sheep farmers, she is less sure of warding off the attractive young bounty hunter who charms his way into her self-imposed solitude. Can she

persuade this would-be Wyoming sheep rancher of the merits of predators, and so trust him in her forest?

As Deanna crisscrosses the reserve keeping track of the coyotes' progress and misleading her hunter, we learn the mostly tragic history of this place, of passenger pigeons and Carolina parakeets and heath hens now vanished. Kingsolver does leaven the gloom with wry humor: "In the same plaintive tone her single friends used to complain that all the best men were married, Deanna felt like whining, 'All the best species are extinct.'"

In the valley below, a young woman is coming to grips with the death of her husband of just one year. A city person trained as an entomologist, Lusa Landowski finds the family farm she is left to care for a fantastic burden, both physically arduous and morally challenging. What's a poor farmer to do when the only crop that earns its keep is tobacco?

Amid the resentment of her sisters-in-law who don't believe she belongs on their family home, Lusa struggles to overcome her grief and establish her own place on the farm and in the valley her husband loved as much as he loved her.

Also living in the valley is Garnett Walker, a

lonely old man at war with a changed world, personified by his elderly and free-spirited neighbor, Nannie Rawley. Each believes the other is damaging the farm on their side of the fence with their ways. As they squabble over pesticides and compost piles and organic produce, Garnett tries to resist caving into Nannie's admittedly well reasoned arguments against chemicals and for beneficial insects even as he is more and more drawn to her company. Garnett is easily the most poignantly drawn character in *Prodigal Summer*. This proud champion of manicured farm-scapes managed with chemicals is devoting his retirement to selectively breeding chestnuts, in hopes of finding a blight-resistant strain and thus restoring this once-abundant species. A highly principled man, he is pained to find that he might have done wrong.

In playing out these soap opera-like stories, Barbara

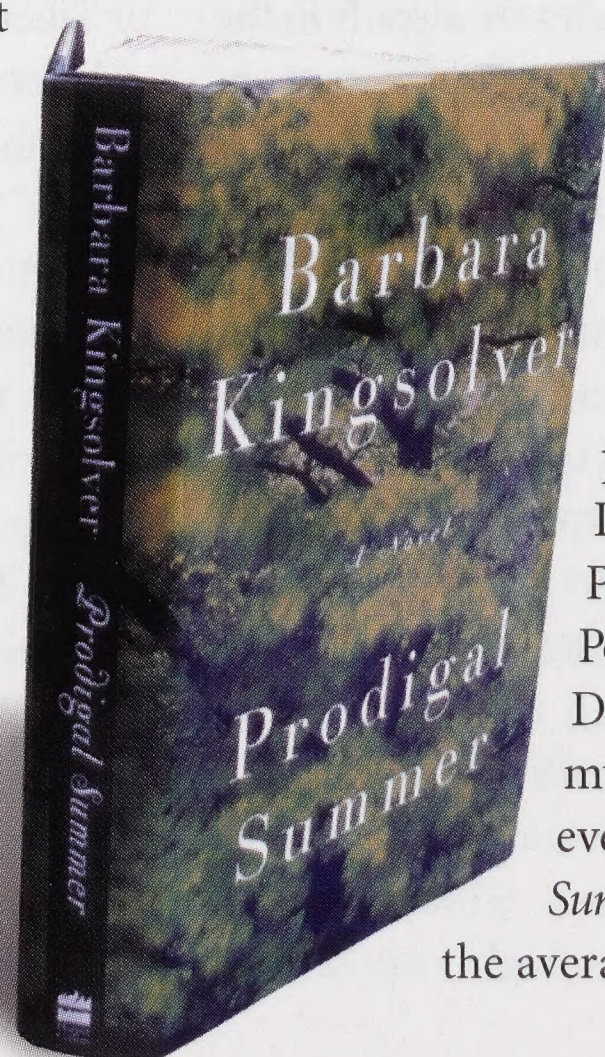
Kingsolver also systematically runs down her list of environmental issues to raise. Invasive plants? Check. Logging? Check. Poachers? Check. Pesticides? Check. Despite these formulaic flaws, however, *Prodigal Summer* rises above the average romance—

and you learn a lot too. Her writing is lyrical, and her descriptions of the natural world are precise and vivid. In fact, this corner of Appalachia is a much better developed character than some of the personalities who people it.

In the end, Kingsolver also reveals a less romantic, more optimistic bent. She transcends her long lament for paradise lost and leaves her characters wanting to live fully in the present. Deanna, who feels the loss of species most keenly, decides, "She would step somehow from the realm of ghosts she'd inhabited all her life to commit herself irrevocably to the present...today she had paid little mind to the sadness of lost things moving through the leaves at the edge of her vision, the shadowy little wolves and the bright-winged parakeets hopping wistfully through the unused cockleburs." In part this transformation comes from watching the coyote family survive the summer and become part—a wonderful part—of the changed landscape. Lusa and Garnett, too, make new connections to place, and face their futures with renewed faith in the power of nature, and neighbors, to give meaning to life.

Prodigal Summer can be read with pleasure at many levels: as love story, as environmental history, as paean to place. Reading it will be a perfect way to while away some of your summer.

—Susan Lumpkin



BIO- ALMANAC

GOOD NEWS

The New Year delivers new hope for some charismatic megafauna. The Republic of Congo has quadrupled the size of Odzala National Park to 5,000 square miles, or nearly half the size of Maryland. Part of the Congo Basin—the world’s second largest tropical forest after the Amazon—Odzala is home to forest elephants, forest buffalos, spotted hyenas, Central Africa’s lone population of lions, more than 400 species of bird, and 16 different primate species, including the world’s greatest concentration of lowland gorillas.

Odzala’s remarkable biodiversity is partly attributable to its large number of *bais*: forest clearings of up to 30 acres that, like savanna waterholes, attract tremendous aggregations of wildlife. The *bais*’ rich salt deposits attract elephants, while their marshy sedges draw gorillas. These open spaces also function as hangouts amid a tangled jungle not otherwise conducive to social interaction.

—from *Conservation International, African Wildlife Foundation, and Environmental News Service*

BAD NEWS

A double dose of bad news from the Galápagos Islands. On the night of January 16, the Ecuadorian tanker *Jessica*, carrying 243,000 gallons of diesel and fuel oil, struck a reef 800 yards off the coast of San Cristóbal Island—the easternmost island in the archipelago. At least 185,000 gallons of oil leaked into the

Pacific Ocean. Fortunately, only a small number of sea lions, blue-footed boobies, albatrosses, and pelicans have been affected so far.

Made famous by Charles Darwin’s musings about natural selection, the Galápagos Islands—now a World Heritage Site—suffered another environmental setback last November. Mobs of fishermen, upset by the Ecuadorian government’s enforcement of a harvest limit on spiny lobsters and sea cucumbers, occupied and vandalized government and research facilities throughout the archipelago. The fishermen particularly targeted the offices of the Galápagos National Park Service and the Charles Darwin Research Station, where several critically endangered giant tortoises were kidnapped, and ten giant tortoise embryos, on the verge of hatching, died after incubation equipment was stolen.

—from *The Associated Press and Environmental News Service*

MORE RUBBISH AND HOT AIR

As California residents face power outages and as gas prices soar, renewable energy sources offer potential long-term solutions. Many such technologies are already in the works. Amsterdam’s metro system, for example, has been running on garbage since early January. Though not considered one of the three primary green energy sources—those being sun, wind, and water—incineration of non-recyclable waste in the Dutch capital fuels 236 trams and 106 metro trains, as well as powering Amsterdam’s city hall, its performing arts center, and streetlamps in a city square.

Here in the United States, the world’s largest wind farm is scheduled to begin operations

by the end of the year. Straddling the Washington—Oregon state line, the cluster of 450 windmills should provide energy to 70,000 homes in 11 Western states. The windmills’ unique design optimizes production through a pivoting head that always faces the wind. Conservationists hope the use of wind power will reduce emissions of greenhouse gases, the chemicals that cause global warming.

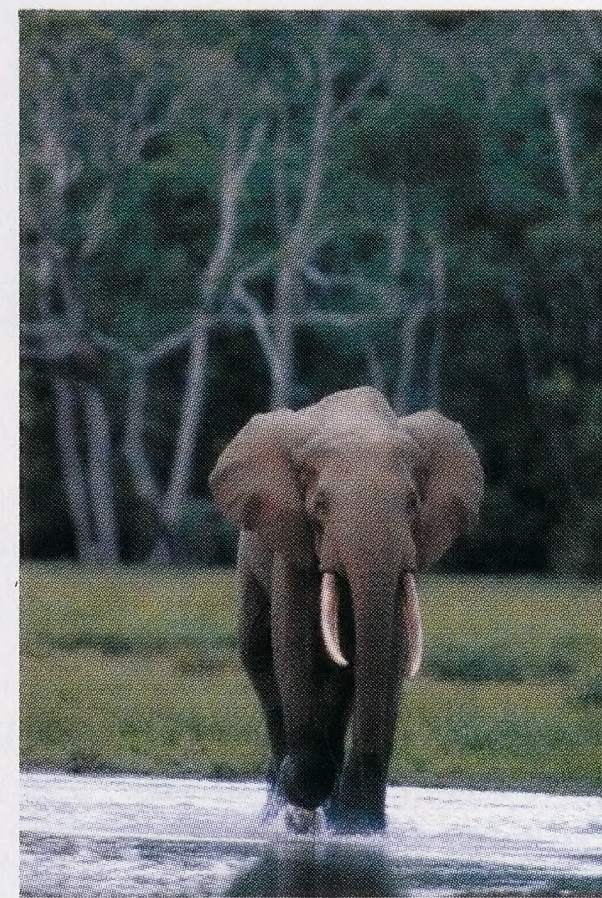
Even the small Scottish island of Islay has joined the energy game, having christened the world’s first commercial wave power plant last November. The wave power station will provide enough juice to light 400 homes—not much in the greater scheme of global power needs, but enough to highlight the potential for reliable sources of renewable energy.

—from *Planet Ark and ENN.com*

WHAT’S IN A NAME?

Shahtoosh—the wool of the chiru, or Tibetan antelope—derives from a dialect of Persian and is understood to mean, roughly, “the king of wools.” (*Shah* means “king,” and *toosh* means “ability,” or may come from *poosh*, which means “garment,” or *stos*, the local name for chiru in the northern Indian region of Ladakh.) The fact that an antelope from Tibet whose wool is woven in India bears a Persian name testifies to the collisions of culture along the ancient Silk Road.

Shahtoosh itself is sometimes confused with, woven into, and smuggled under *pashmina*—wool



FOREST ELEPHANT IN ODZALA.

processed from the soft undercoat of a breed of the domestic goat (*Capra hircus*), but perhaps originally from the Siberian or Himalayan ibex (*Capra sibirica*). The

word “*pashmina*” comes from *pashm*, the Persian word for wool. This fabric is more broadly known as cashmere, so named because it was first processed by expert weavers in Kashmir, the mountainous region today fought over by India and Pakistan. However, cashmere shouldn’t be confused with cassimere, a smooth, twilled fabric—similar to serge—ordinarily made from sheep’s wool. (Incidentally, the words “serge” and “silk” both derive from *Seres*, an ancient Greek and Roman reference to China, the Land of Silk.)

Shahtoosh also can be diluted with angora wool—or mohair—from the Angora goat, a long-haired breed of the common domestic goat. Angora wool, however, can also refer to yarn processed from the hair of the Angora rabbit. “Angora” itself is the former name for Ankara, the modern-day capital of Turkey, where goats were first bred for mohair. No, “mohair” doesn’t mean “lots of hair,” but rather derives from the Arabic *mukhayyar*, meaning “choice” or “select.”

Don’t be confused by all this etymology—or by dealers pulling the wool over the eyes of customers who can’t tell the fabrics, or their potentially endangered sources, apart.

—Alex Hawes and Matthew Huy





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